

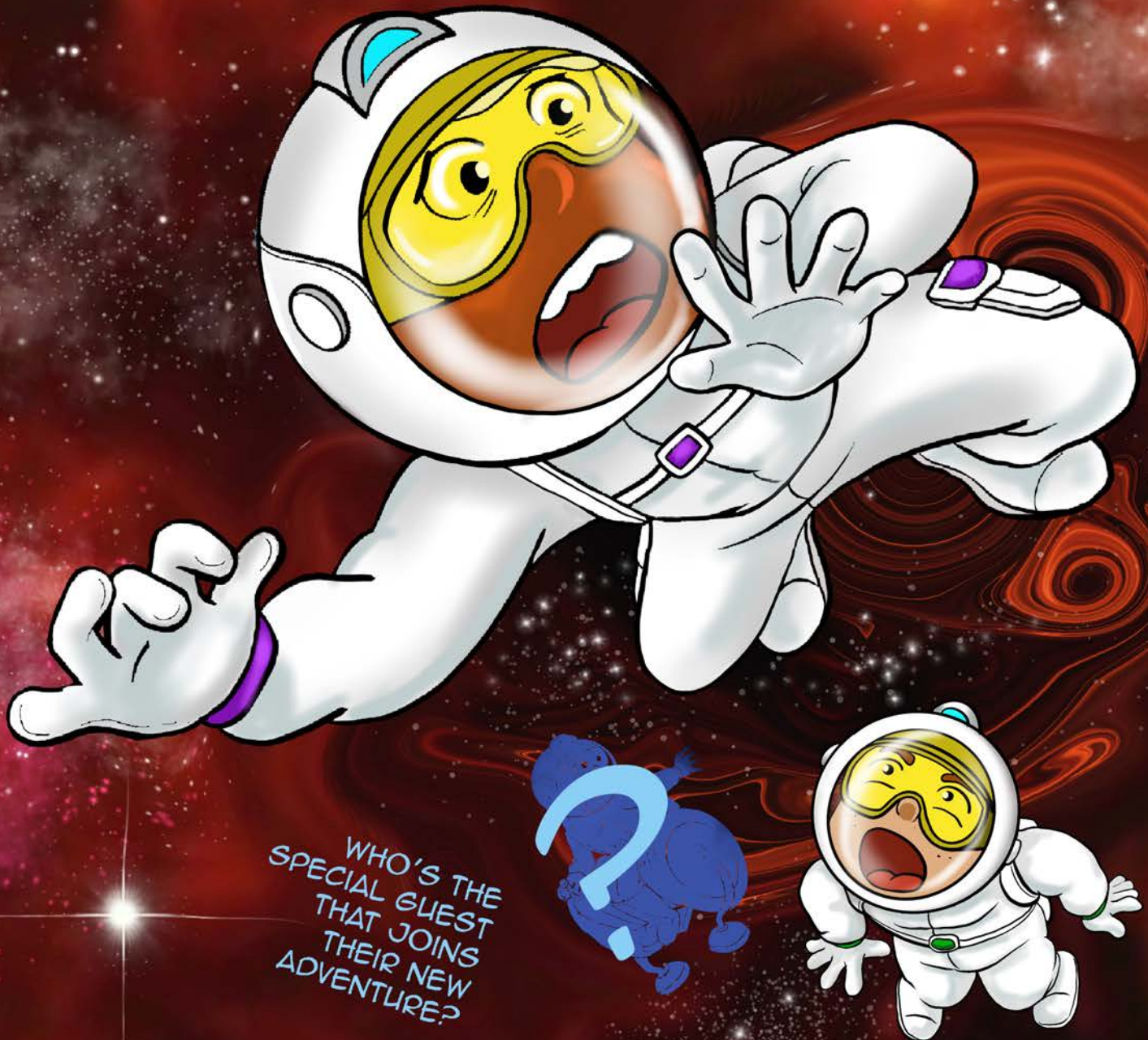
GALAXY SCOUTS



Space-Ventures with Stella and Riley

VOLUME 2

WHAT IS
DARK
MATTER?




WHO'S THE
SPECIAL GUEST
THAT JOINS
THEIR NEW
ADVENTURE?

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The comic idea was developed by Cottrell Scholars: Snezana Stanimirovic (University of Wisconsin, Madison), Karen Bjorkman (University of Toledo), Michael Gladders (University of Chicago), Bo Hammer (American Institute of Physics), Sarbajit Banerjee (University at Buffalo, SUNY), Yadong Yin (University of California, Riverside).

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NEXT DAY...



RILEY!
WAKE UP!

HUH? COOL IT,
MOM, GIVE ME
ONE MORE
MINUTE.



RILEY, WAKE UP!
WE JUST WENT TO MARS!
CAN YOU BELIEVE IT! THAT
WAS AMAZING! MARS WAS
SO RED, AND THE ROBOT
TALKED TO US.

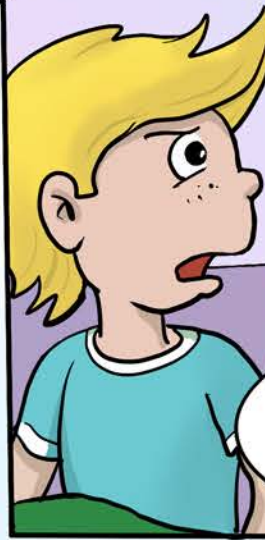
YAWN.
SKIP IT, STELLA.
IT WAS JUST A
WEIRD DREAM.

OOOOOH, CHECK
IT OUT. RILEY HAS A
NEW GIRLFRIEND.



PPFFT. SHE
WISHES.

RILEY,
ARE YOU
LISTENING?



YEAH, CUTE
COUPLE, I'D
SAY. HA HA HA.



RILEY, IT
WASN'T A
DREAM.



RILEY, DID YOU
HEAR WHAT I
SAID?

JUST LEAVE
ME ALONE!
FORGET IT.



BUT RILEY...
WE... REALLY...
OH MY!



OK, EVERYONE,
LINE UP AND LET'S
GET THIS BUS LOADED
UP. ROLL CALL!

REX
MORE.



HERE...



WHAT? IT'S
MR. HALLEY!?

TWO WEEKS LATER

WHO CAN NAME ALL THE PLANETS VISIBLE WITH THE NAKED EYE?

VENUS!

MARS!

MERCURY!

JUPITER?

SATURN!

THAT'S A VERY GOOD QUESTION, STELLA. THE SURFACE OF MARS HAS A LAYER OF RUSTY DUST THAT HAS A RED COLOR. THAT'S WHY MARS ALWAYS LOOKS RED.

MRS. JAAX! DOES LIFE EXIST ON TRAPPIST-1 PLANETS?

MRS. JAAX, WHY IS MARS CALLED THE "RED PLANET"?

STELLA, PLEASE STAY FOCUSED ON OUR LESSON TODAY.

NEXT TIME YOU VISIT THE GRIFFITH OBSERVATORY, THIS QUESTION IS PERFECT FOR DR. DAVE.

OR A SHRINK. HAHHA!

RILEY!

SPLAT





OKAY, CLASS. PICK UP YOUR PHONES BEFORE YOU LEAVE!



WHERE DID HE GO? I SAW HIM.



COMING THROUGH.



HEY!

WHAT THE HECK? HUH?



IT WASN'T A DREAM. HE'S REAL. IT WASN'T A DREAM. I CAN PROVE IT.



SEE? IT'S MR. HALLEY!

WHAT?

HI, KIDS!



WHERE HAVE YOU BEEN? IT'S BEEN FOREVER!

IT WAS JUST TWO WEEKS. I'VE BEEN BUSY PLANNING YOUR NEXT TRIP...THE LAST ONE WAS JUST A TEST. YOU PASSED!



YOU TWO ARE THE TEAM I'VE BEEN LOOKING FOR. TOGETHER WE CAN DISCOVER THE SECRETS OF THE COSMOS.



YOU MEAN WE CAN GO ON ANOTHER ADVENTURE?



EXACTLY. COME BACK TO THE ZEISS TELESCOPE ON SATURDAY 1:00 P.M. SHARP.

COME TOGETHER. I NEED YOU TWO TO BE A TEAM. YOU BOTH ARE SMART AND BRAVE IN A DIFFERENT WAY.



WE WILL BE THERE!



A TEAM?

GREAT!



WE NEED A TEAM NAME. THE DYNAMIC DUO?

THAT'S ALREADY TAKEN.

HOW ABOUT GALAXY SCOUTS?

JEEZ

SATURDAY, ON THE WAY TO THE OBSERVATORY...

YOU AND YOUR BIG IDEAS. I COULD HAVE BEEN PLAYING BASEBALL WITH THE GANG

BUT YOU HEARD WHAT MR. HALLEY SAID.

YOU CAN PLAY BASKETBALL ANY TIME.

BASEBALL!! UGH, GIRLS!!

WHATEVER! YOU KNOW WHAT I MEAN!!

WE'RE HERE! ISN'T THIS EXCITING? I WILL PICK YOU UP AFTER THE TOUR!

YEAH, I'M GONNA FAINT FROM THE THRILL! OOF!

BYE, MOM!

AT THE OBSERVATORY...

OKAY, EVERYONE, FOLLOW ME. WELCOME TO THE GRIFFITH OBSERVATORY.

THE OBSERVATORY WAS BUILT IN 1935 BY GRIFFITH J. GRIFFITH, WHO WANTED EVERYONE TO BE ABLE TO SEE SPACE THROUGH A TELESCOPE. SO, HE CAME UP WITH THE IDEA OF A "PUBLIC OBSERVATORY".

DR. DAVE, CAN WE SEE THE CHRISTMAS STAR?

SADLY NOT. THE CHRISTMAS STAR ISN'T REALLY A STAR. IT IS WHEN JUPITER AND SATURN ARE SO CLOSE TO EACH OTHER, THEY APPEAR AS A SUPER BRIGHT POINT OF LIGHT.

THIS SPECTACULAR EVENT IS VERY RARE. IT HAPPENED ON DEC. 21, 2020 FOR THE FIRST TIME SINCE THE MIDDLE AGES.

BUT WE CAN SEE THE "EVENING STAR" - WE USE THIS NAME FOR VENUS WHEN IT IS VISIBLE RIGHT AFTER SUNSET.



HERE IS OUR CHANCE. LET'S GO!

YEAH. YEAH.



THERE HE IS!

OVER HERE! TODAY IS THE BIG DAY.

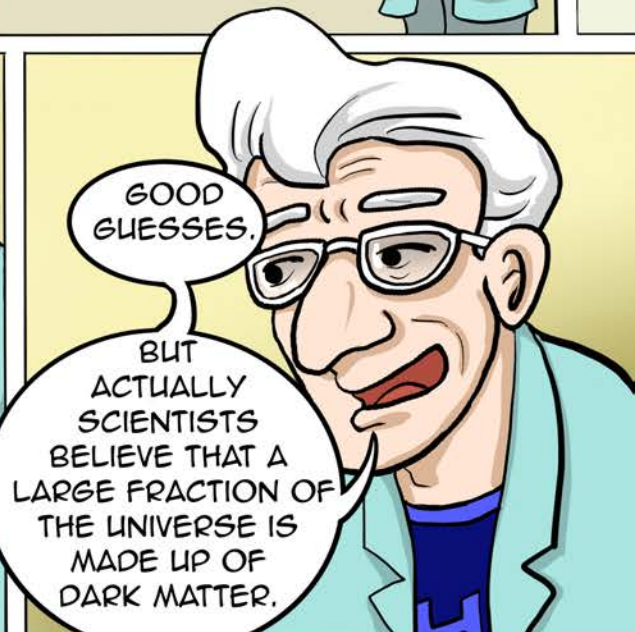
HI, MR. HALLEY!



I HAVE A QUESTION FOR YOU. WHAT DO YOU THINK THE UNIVERSE IS MADE OF?

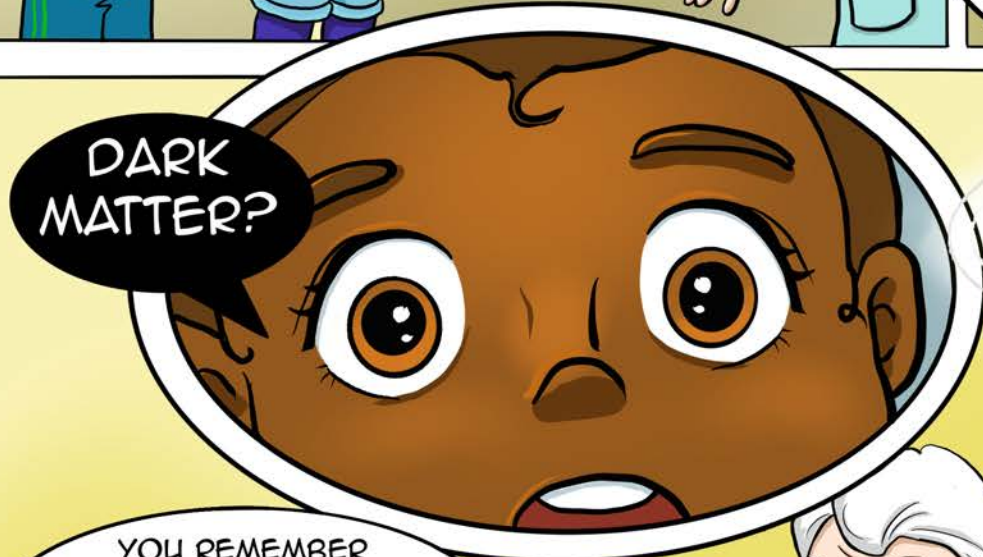
STARS?

PLANETS?



GOOD GUESSES.

BUT ACTUALLY SCIENTISTS BELIEVE THAT A LARGE FRACTION OF THE UNIVERSE IS MADE UP OF DARK MATTER.



DARK MATTER?

YOU REMEMBER FROM SCHOOL THAT THE FORCE OF GRAVITY KEEPS ALL OF THE PLANETS IN ORBIT AROUND THE SUN.

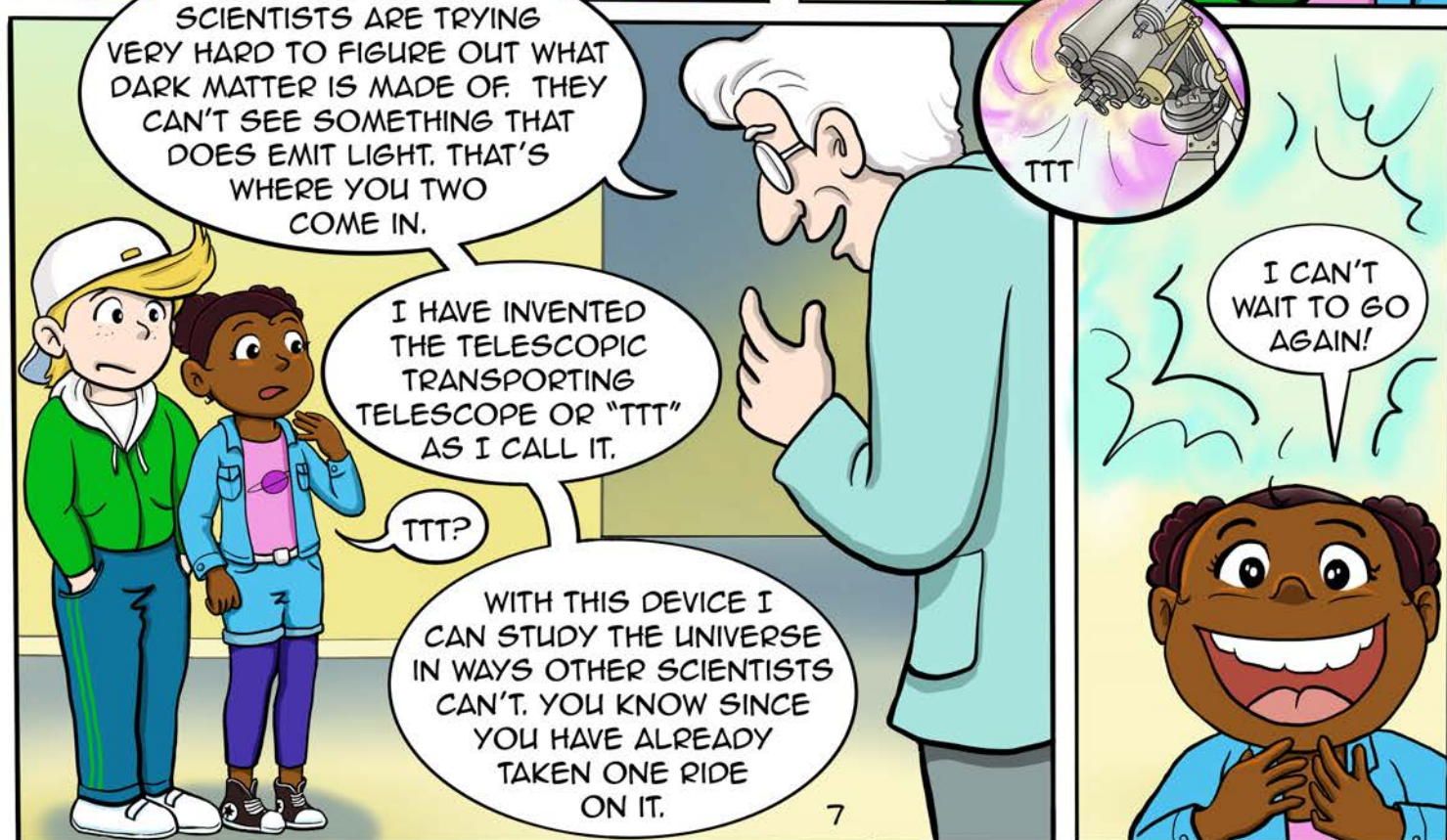
THE SAME FORCE KEEPS STARS IN ORBIT AROUND THE CENTER OF OUR MILKY WAY GALAXY. SO, NO STARS OR PLANETS FLOAT AWAY OR FLY OFF.

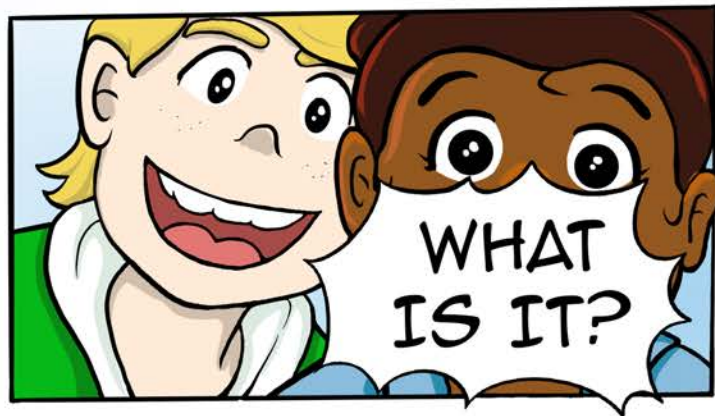
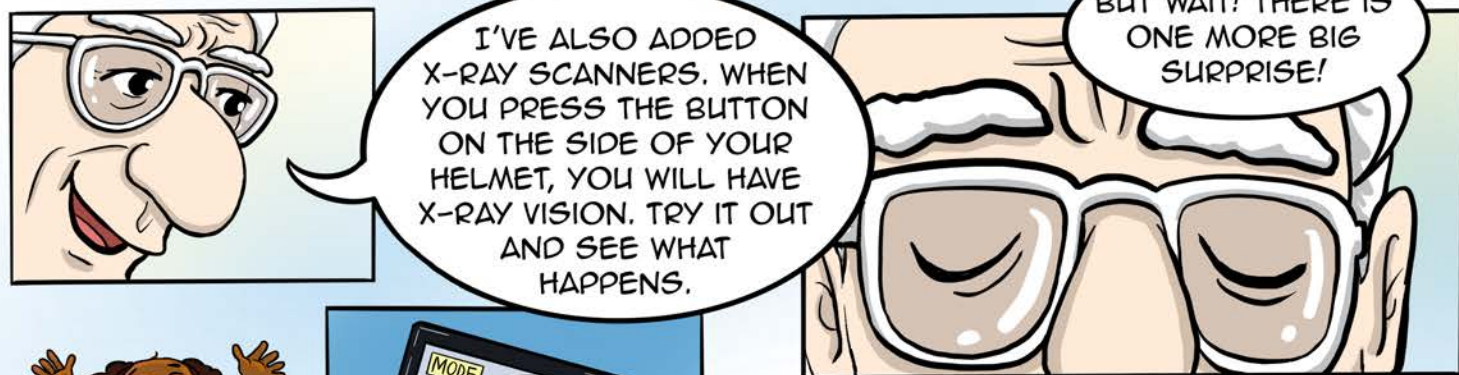
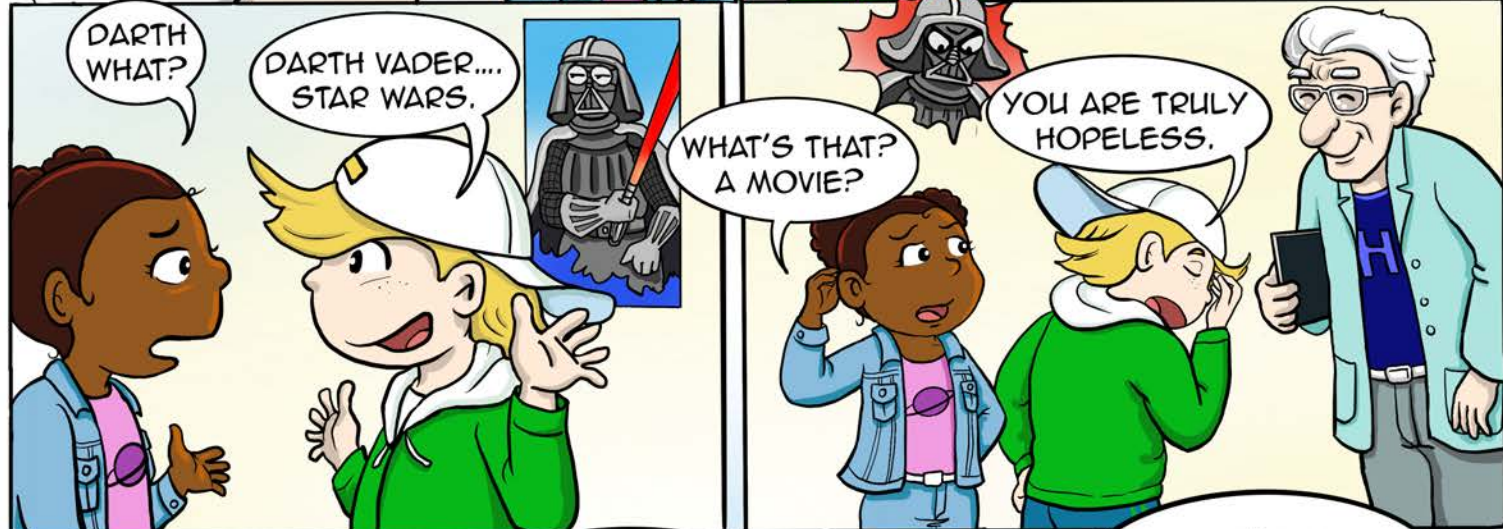
STARS ORBITING FAR AWAY FROM THE CENTER WILL EXPERIENCE A SMALLER GRAVITATIONAL FORCE AND SO WE WOULD EXPECT THEM TO SLOW DOWN.

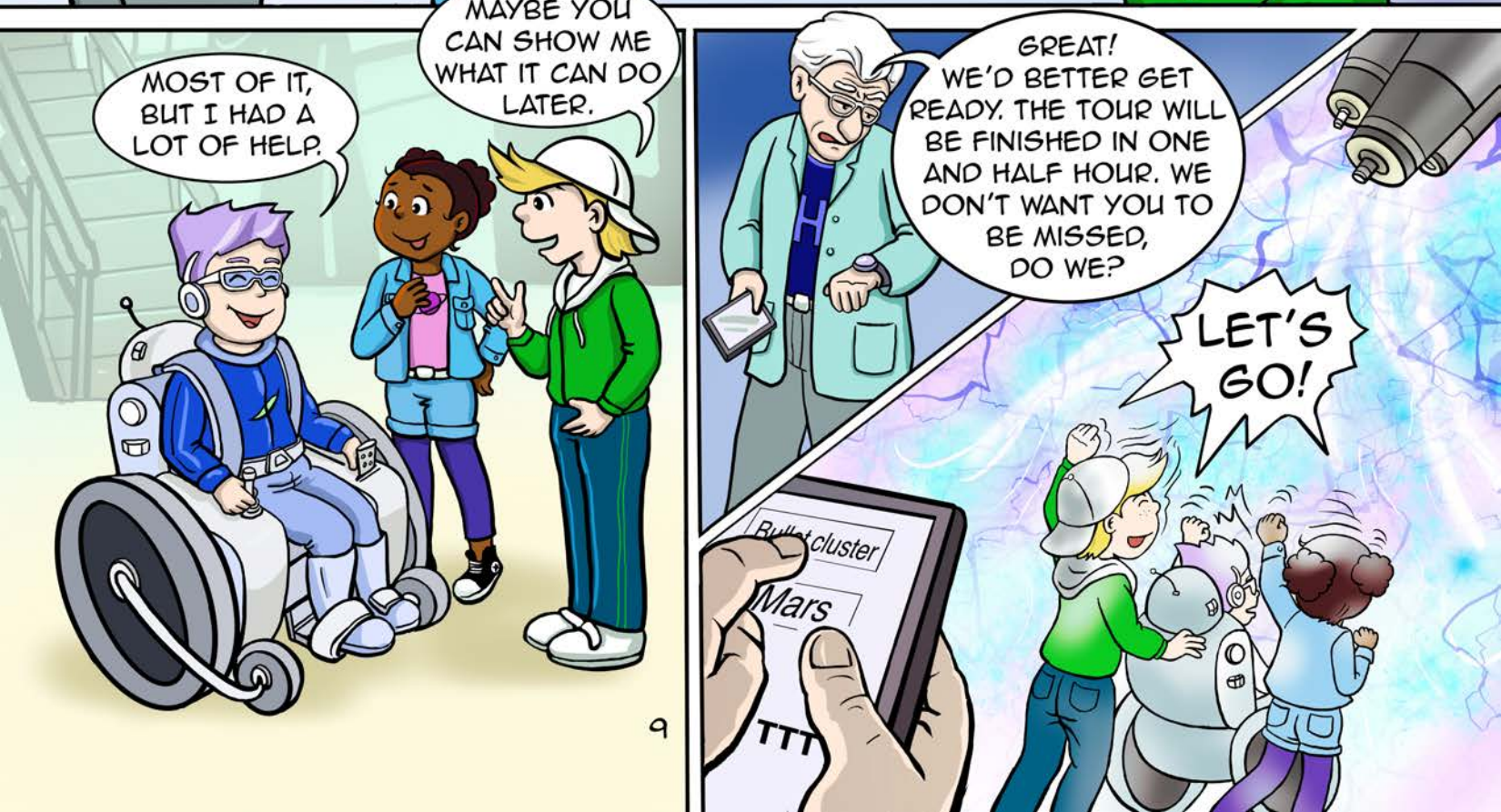
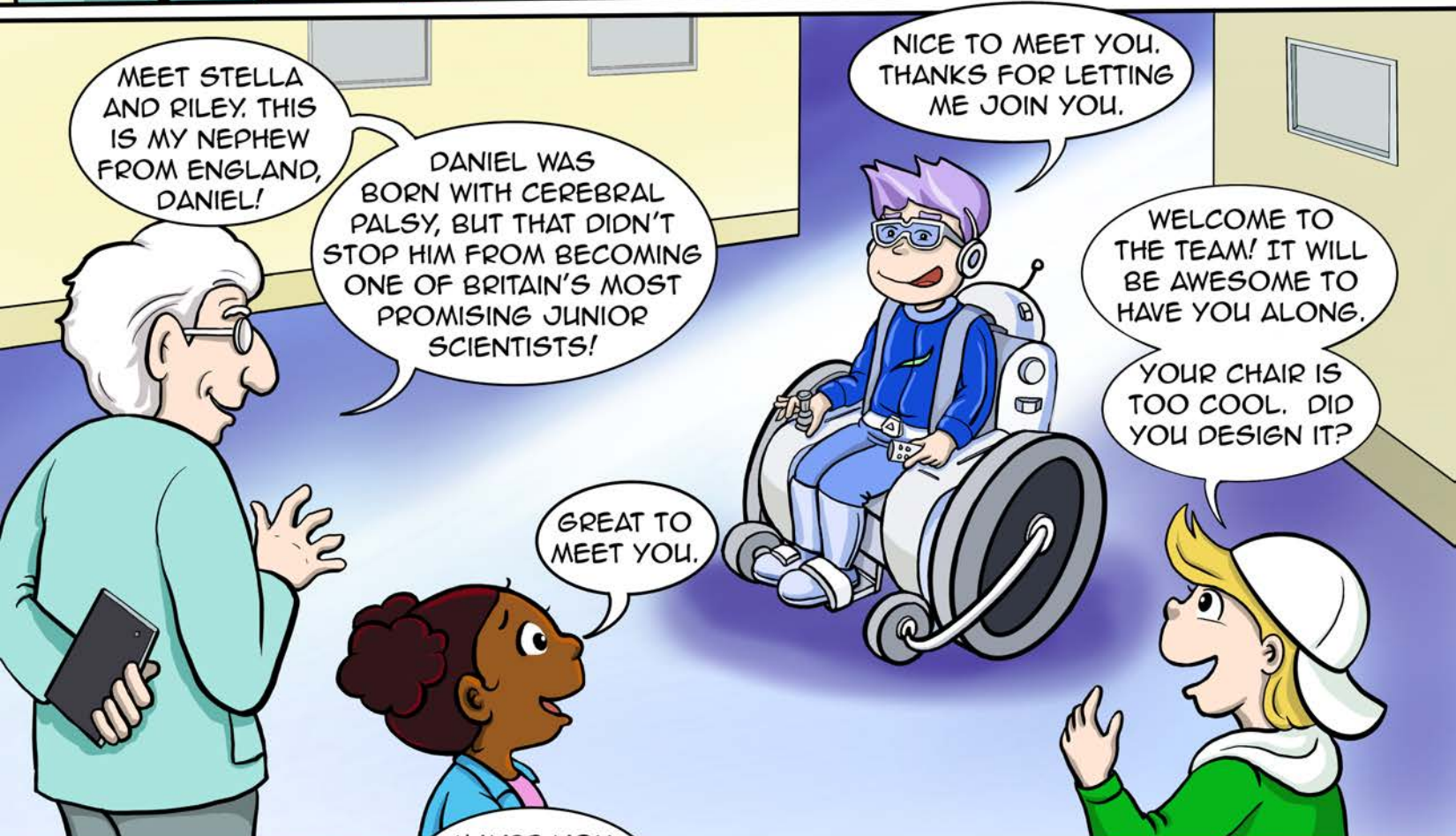
BUT SCIENTISTS HAVE ACTUALLY OBSERVED THE OPPOSITE - FAR AWAY STARS ARE ACTUALLY MOVING AS FAST AS THE STARS CLOSE TO THE CENTER OF THE MILKY WAY. VERY MYSTERIOUS...



THESE STARS MOVE AS IF THERE IS SOME INVISIBLE MATTER THAT PULLS THEM TIGHT. WE CALL IT DARK MATTER.







ZZAAAAAAAAPPPP

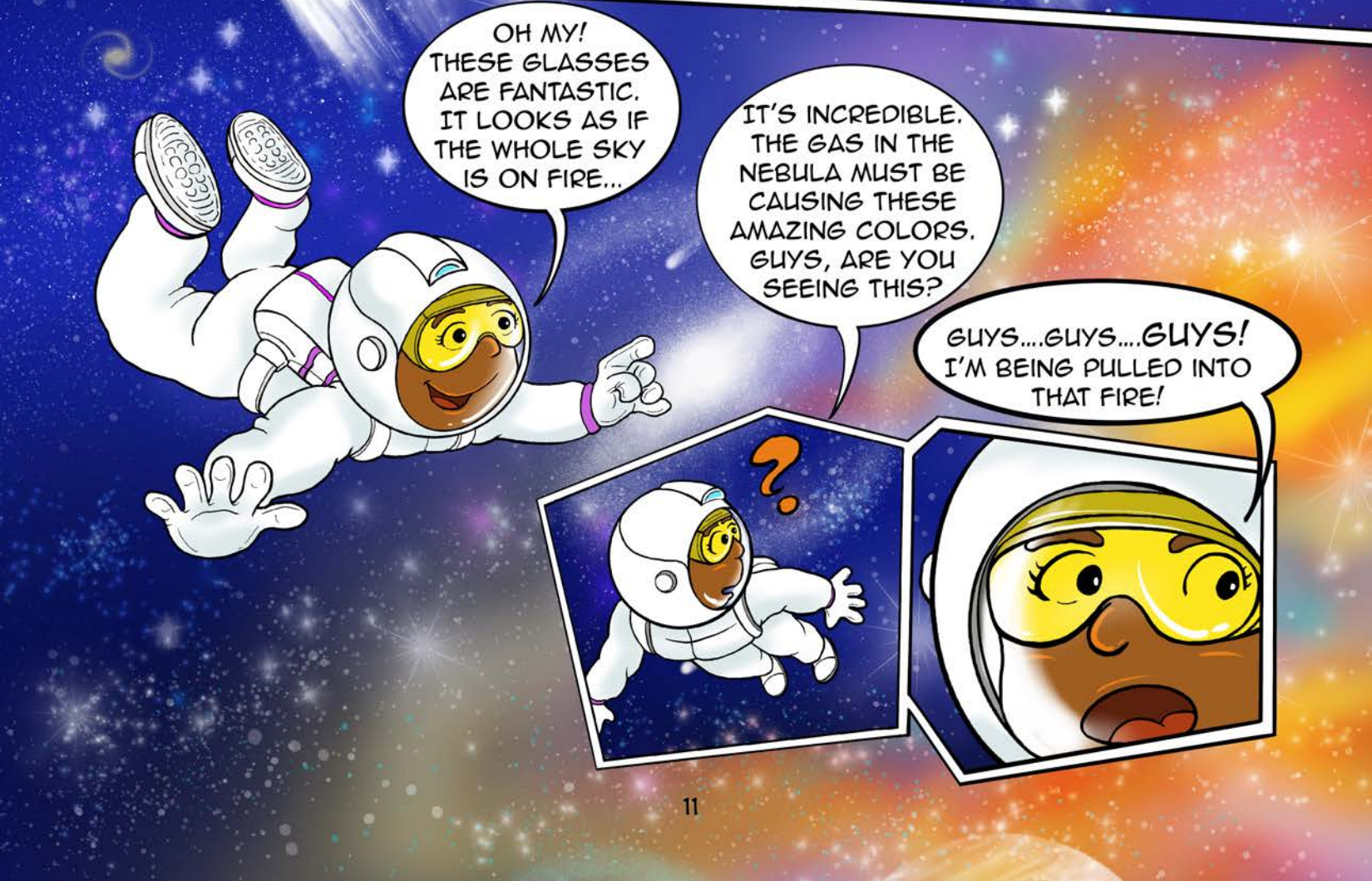
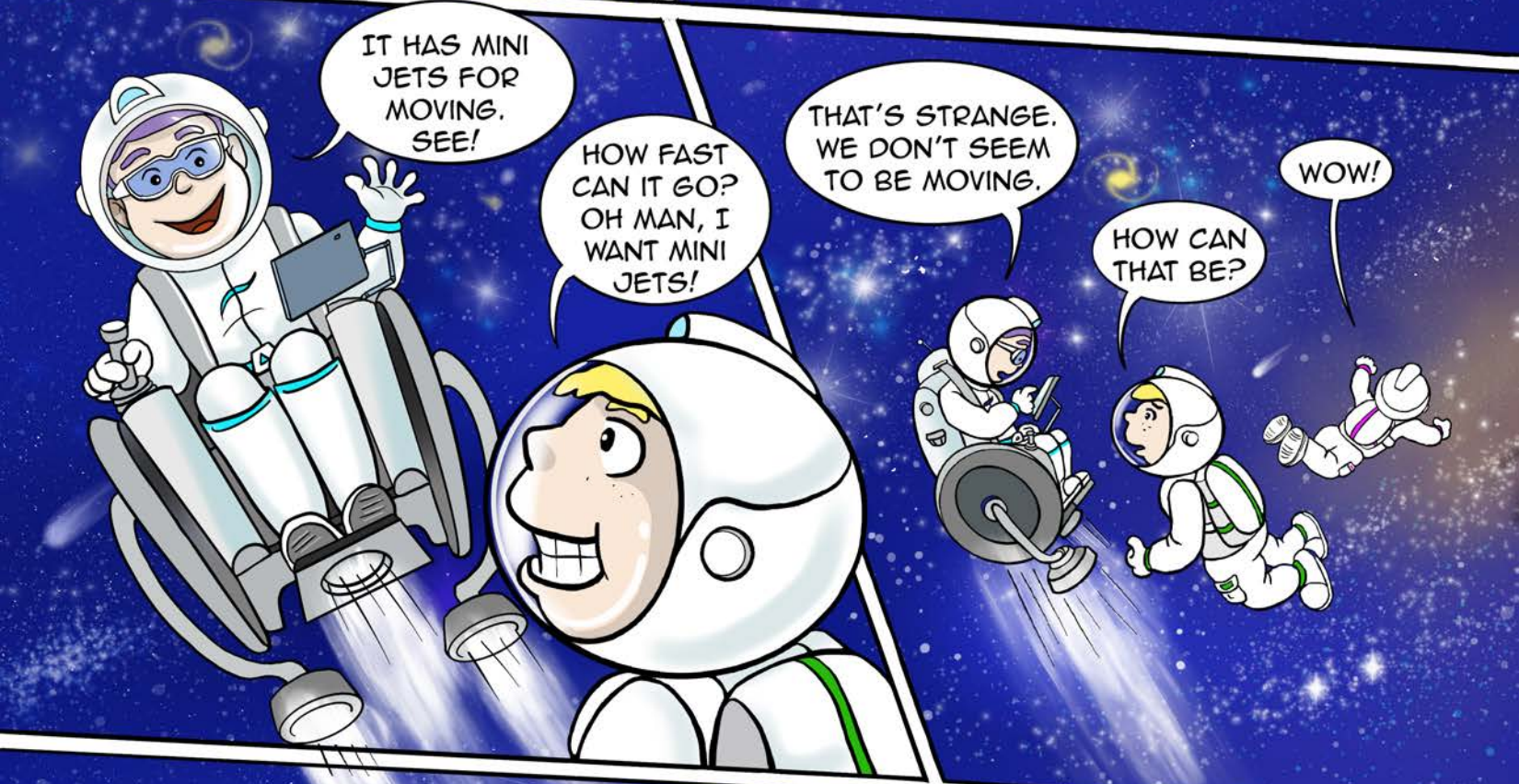
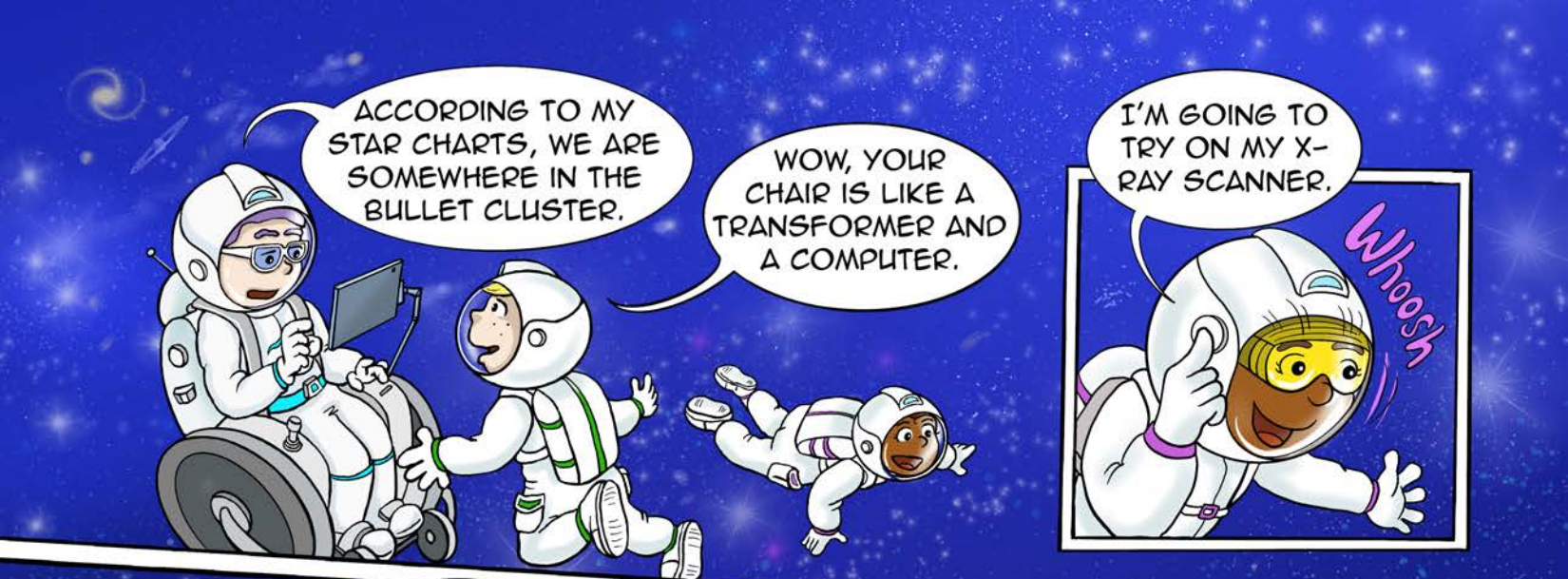
WHAT A RUSH!

THAT WAS MOST EXHILARATING!

SOOOOOOOO
BEAUTIFUL!
YOU CAN SEE
GALAXIES!

WOW!

WHERE ARE WE?






ARE YOU GUYS LISTENING? I'M BEING PULLED INTO THAT ENORMOUS FIRE!



WHAT FIRE?



WHAT ARE YOU TALKING ABOUT? STELLA, ARE YOU USING THE X-RAY SCANNER?




TURN ON YOUR X-RAY SCANNER!



LOOK! WHAT IS THAT?



I SEE IT!



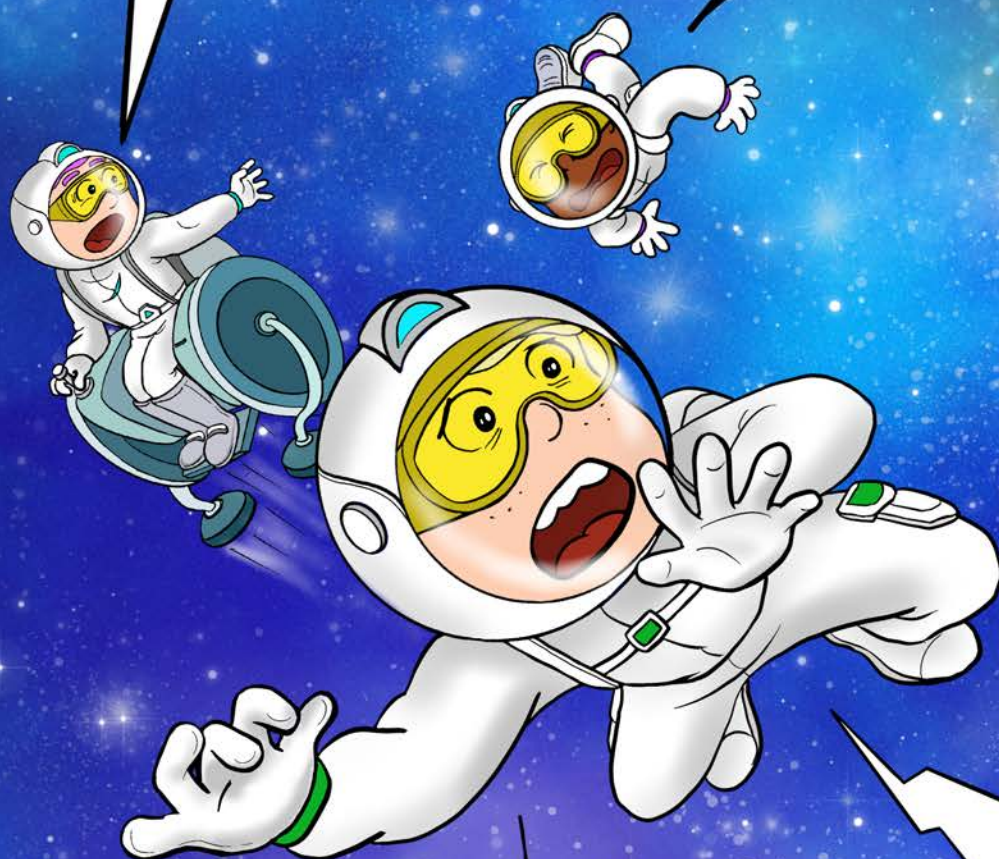
SEE WHAT?! OH, SOMETHING IS HIDING IN THE NEBULA.



LOOK!
A DRAGON!
WE'RE GETTING
PULLED
INTO IT!

IT'S
GONNA
EAT US!

WHAT IS THE
SAFE WORD?
DARK MATTER?
AHHH...WHAT'S
THAT WORD?

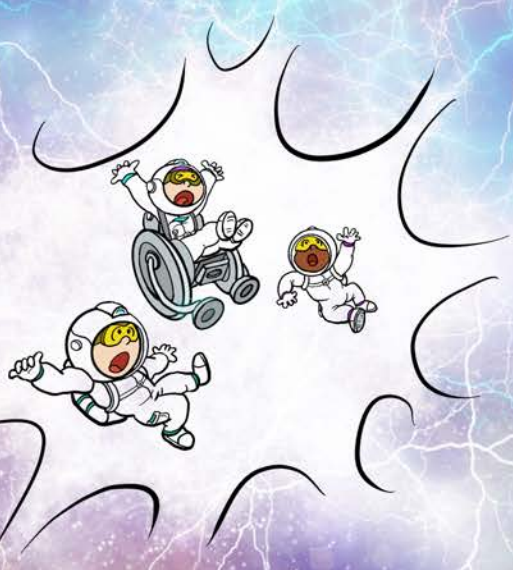


WE'D
BETTER GET
OUT OF
HERE!

**DARTH
VADER!!**



THWP





WELL, THAT WAS A FAST TRIP. WHAT HAPPENED? YOU'VE ONLY BEEN GONE FOR 15 MINUTES!



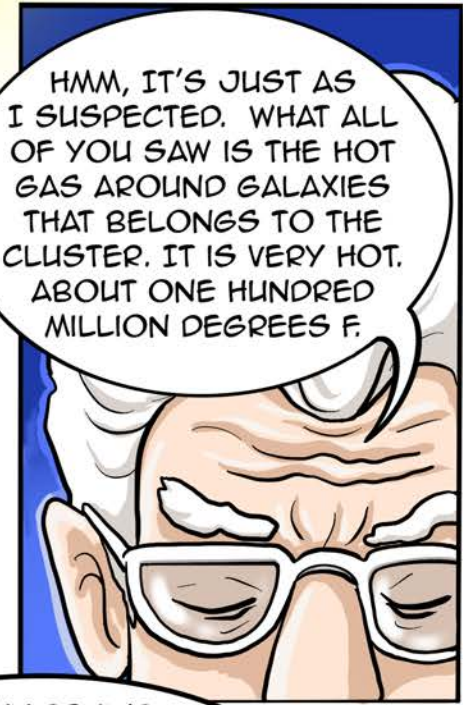
I WAS BEING PULLED TOWARDS A BEAUTIFUL GLOW BETWEEN GALAXIES. AND THEN SUDDENLY THE COLORS GOT BRIGHTER AND A HUMONGOUS DRAGON BEGAN TO COME OUT OF THE SWIRLING COLORS.



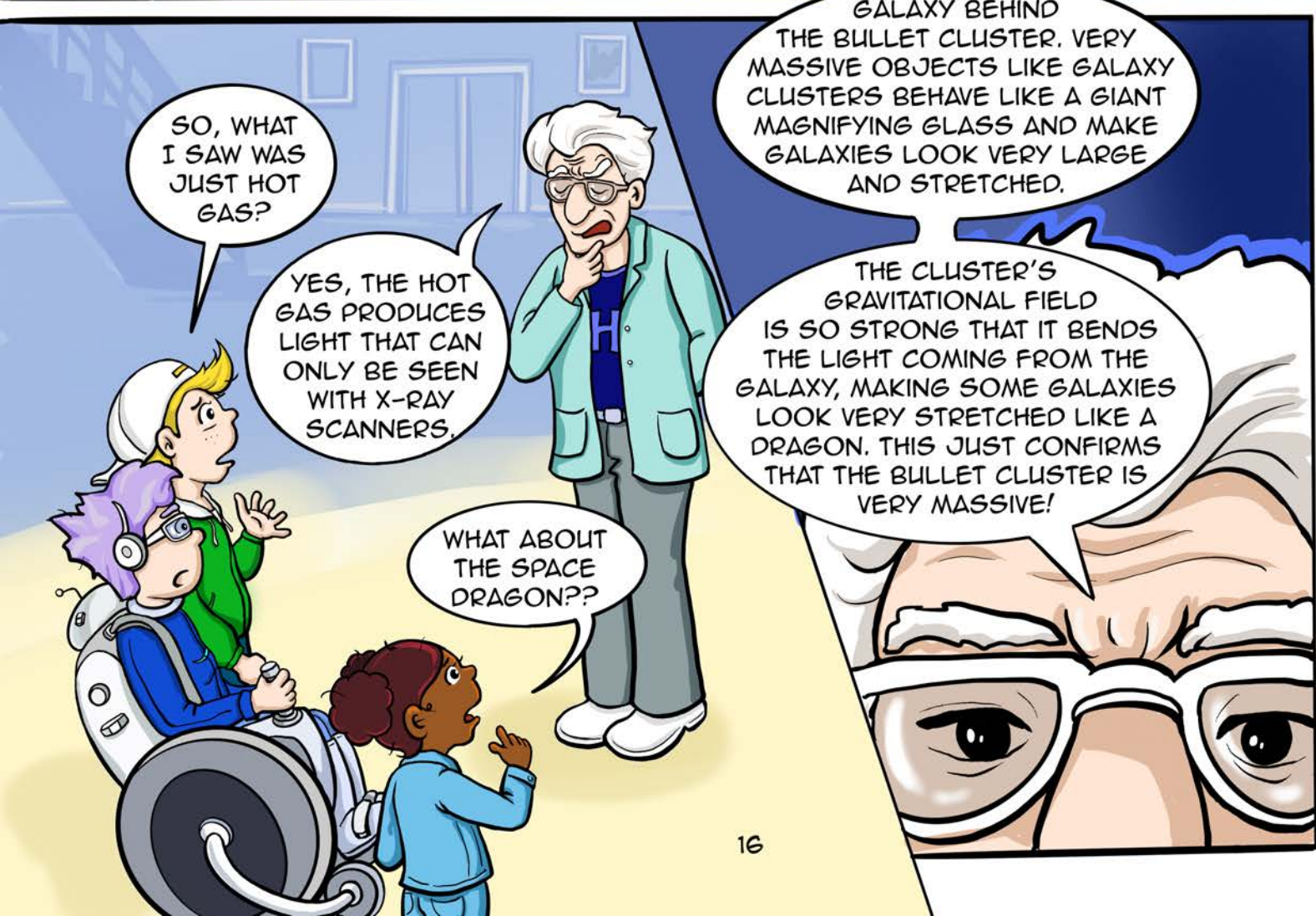
WE FOUND THAT EVEN THOUGH WE HAD MY JETS ON, WE WEREN'T MOVING AT ALL.

AND IT WAS GETTING HOTTER!

"HOTTER"?! I WAS BEING BOILED ALIVE, AND, I WAS ABOUT TO BE EATEN BY A COSMIC DRAGON!



HMM, IT'S JUST AS I SUSPECTED. WHAT ALL OF YOU SAW IS THE HOT GAS AROUND GALAXIES THAT BELONGS TO THE CLUSTER. IT IS VERY HOT. ABOUT ONE HUNDRED MILLION DEGREES F.



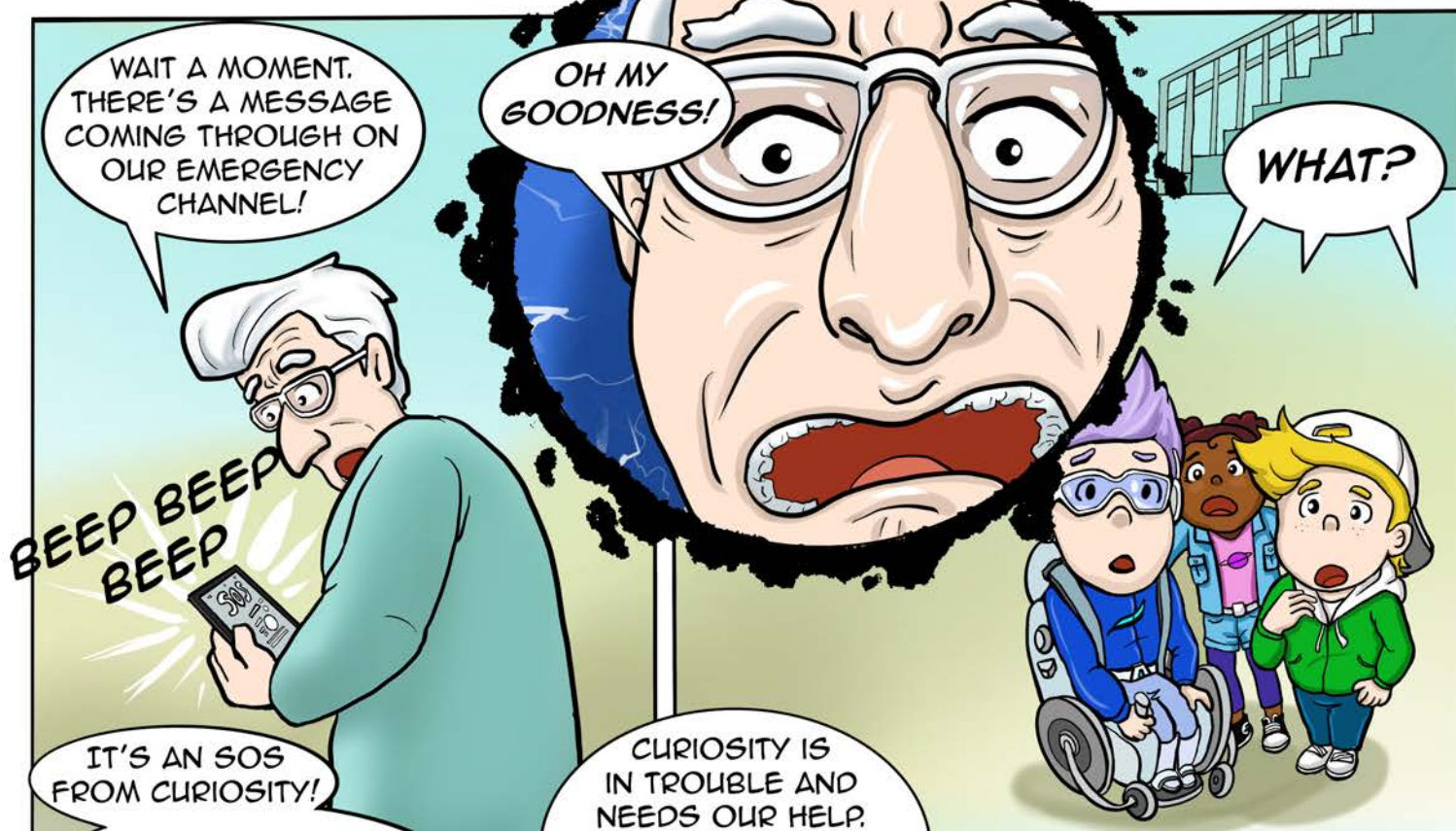
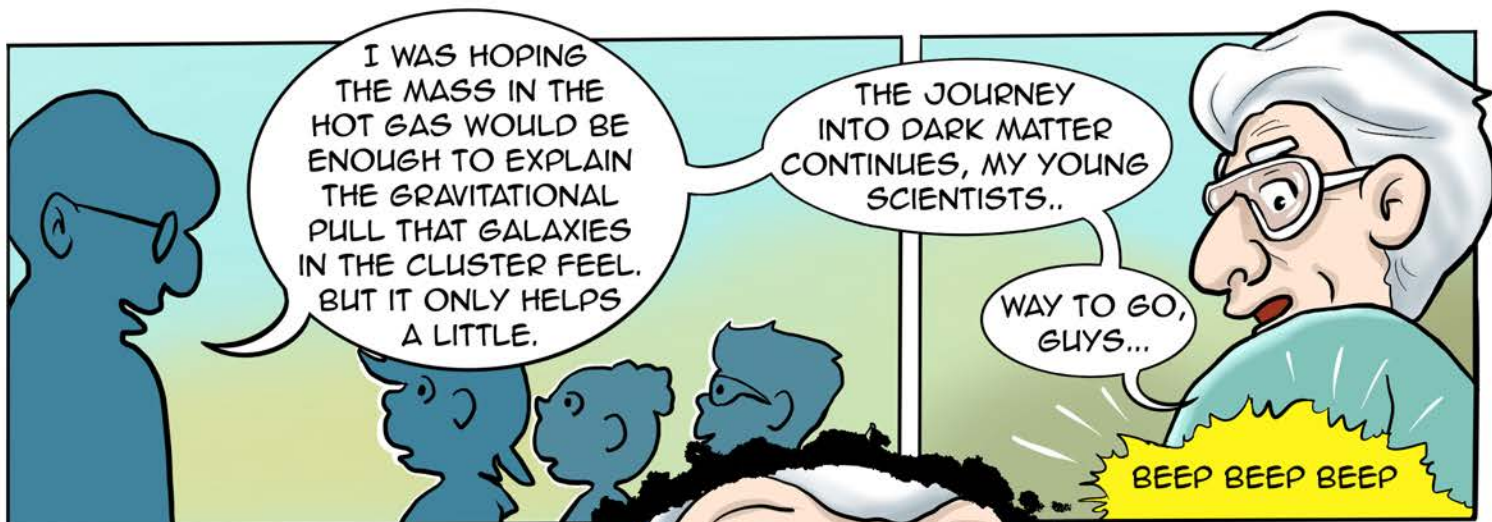
SO, WHAT I SAW WAS JUST HOT GAS?

YES, THE HOT GAS PRODUCES LIGHT THAT CAN ONLY BE SEEN WITH X-RAY SCANNERS.

WHAT ABOUT THE SPACE DRAGON??

GALAXY BEHIND THE BULLET CLUSTER. VERY MASSIVE OBJECTS LIKE GALAXY CLUSTERS BEHAVE LIKE A GIANT MAGNIFYING GLASS AND MAKE GALAXIES LOOK VERY LARGE AND STRETCHED.

THE CLUSTER'S GRAVITATIONAL FIELD IS SO STRONG THAT IT BENDS THE LIGHT COMING FROM THE GALAXY, MAKING SOME GALAXIES LOOK VERY STRETCHED LIKE A DRAGON. THIS JUST CONFIRMS THAT THE BULLET CLUSTER IS VERY MASSIVE!



Glossary

Planets visible to the naked eye: Five planets in the solar system are visible to the naked eye: Mercury, Venus, Mars, Jupiter, and Saturn

Mars “the red planet”: The surface material (or regolith) of Mars contains a lot of iron oxide (FeO), and it is what gives Mars its red color. Earth also has a lot of FeO but most of it sunk to the core of the planet; while Mars, due to its smaller size and weaker gravity, has much more FeO on its surface.

Trappist-1 planets: Trappist-1 is a star in the Milky Way with a planetary system consisting of seven planets. Four of the seven planets are located in the star’s habitable zone and are potentially hospitable for life.

Griffith Observatory: An observatory in Los Angeles, USA. It is named after its benefactor, Griffith J. Griffith. The observatory was opened in 1935. Griffith's objective was to make astronomy accessible to the public, as opposed to the dominant idea that observatories should be located on remote mountaintops and restricted to scientists.

Zeiss telescope: The 12-inch (30.5 cm) optical refracting telescope at the Griffith Observatory. Refracting telescopes use lenses to focus the light and form images of astronomical sources.

Mars rovers: Motor vehicles designed to travel on the surface of Mars, collecting information and exploring the planet. As of 2022, there have been six Mars rovers: Sojourner (1997), Spirit (2004–2010), Opportunity (2004–2018), Curiosity (2012–), Perseverance (2021–), and Zhurong (2021–).

Christmas star: Refers to Jupiter and Saturn when they cross paths so close to each other that they are barely distinguishable from one another to the naked eye. One such event happened on December 21st, 2020 when Jupiter and Saturn were so close in the sky that they appeared as one bright shining star in the sky, which we call the Christmas star. We will have to wait until the year 2080 for this to happen again.

Evening star: As the planet Venus always appears close to the Sun in the sky, it is visible usually soon after sunset in the evening or in the morning just before sunrise. This is why Venus is frequently called the Evening or Morning star.

Dark matter: An invisible, mysterious type of matter in the universe that scientists have not been able to detect directly, using existing telescopes. It is called “dark” because it does not interact with light and is therefore impossible to detect directly. However, we can sense its presence through the gravitational force it exerts. For example, due to the presence of dark force, galaxies revolve or orbit around their centers much faster than would be expected, if we account for all the matter that can be directly measured (e.g. stars, gas). The presence of dark matter explains why galaxies orbit so fast.

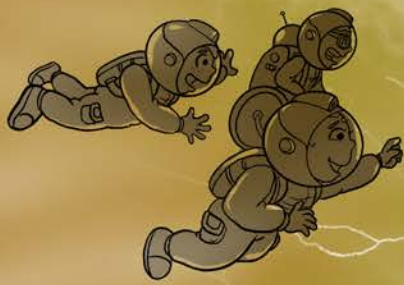
Glossary

X-ray: A type of light. There are several types of light, all each having different wavelengths of radiation. X-ray light has a smaller wavelength and carries more energy than the visual light that we can see (colors of the rainbow). Many astronomical sources, such as disks around black holes, neutron stars, binary star systems, supernova remnants, and stars, give off X-ray light.

Bullet Cluster of galaxies: Galaxies exist in a group or cluster of other galaxies. The Bullet Cluster of galaxies is one of those large groups. It consists of two colliding smaller clusters of galaxies. It is especially well known for providing important evidence of the existence of dark matter.

Intercluster gas: The matter that exists in between galaxies in galaxy clusters. This medium mainly consists of very hot gas that has a temperature of millions of degrees. Intercluster gas can be studied using X-ray telescopes.

Gravitational lensing: The effect that gravity has on the light that travels from distant sources and passes by a massive object. The strong gravitational force of the massive object bends the light, causing multiple images of the distant sources.



STELLA, RILEY AND DANIEL ARE RUSHING
TO CURIOSITY'S RESCUE. WHAT WILL HAPPEN
WHEN THEY GET TO MARS? WHAT HAPPENED
TO CURIOSITY? FOLLOW THEIR ADVENTURES
IN BOOK 3! COMING SOON!